

Application Serial No.: 09/917,649
Applicant: Mark J. Feldstein

Docket No.: N.C. 79,856

Amendments to the Specification:

Please replace the paragraph beginning on page 2, line 6 with the following amended paragraph:

Valveless fluid control has also been developed, thus eliminating the problem of valve clogging by suspended contaminants. For example, pressure control and pressure differentials can switch fluid flow between micro-channels. (Brody, J.P., 1998, U.S. Patent 5,726,404)

According to Brody (col 3, lines 30-62):

The term microchannel is used herein for a channel having dimensions which provide low Reynolds number operation, for which fluid dynamics are dominated by viscous forces rather than inertial forces. The ratio inertial forces to viscous forces is

$$R = \frac{\rho \left(\frac{\delta u}{\delta t} + (u \cdot \nabla)u \right)}{\eta \nabla^2 u} = \frac{\rho d^2}{\eta \tau} + \frac{\rho u d}{\eta}$$

where u is the velocity vector, ρ is the fluid density, η is the viscosity of the fluid, d is the characteristic dimension of the channel, and τ is the time scale over which the velocity is changing (where $u/\tau = \delta u/\delta t$). The term "characteristic dimension" is used herein for the dimension which determines Reynolds number, as is known in the art. For a cylindrical channel it is the diameter. For a rectangular channel, it depends primarily on the smaller of the width and depth. For a V-shaped channel it depends on the width of the top of the "V".

Fluid flow behavior in the steady state, $\tau \rightarrow \infty$ is characterized by the Reynolds number, $R_e = \rho u r / \eta$. Because of the small sizes and slow velocities, microfabricated fluid systems are often in the low Reynolds number regime ($R_e < 1$). In this regime, inertial effects, which cause turbulence and secondary flows, are negligible; viscous effects dominate the dynamics.

Since the Reynolds number depends not only on channel dimension, but on fluid density, fluid viscosity, fluid velocity and the timescale on which the velocity is changing, the absolute upper limit to the channel diameter is not sharply defined.

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This method of fluid control is based on the application and regulation of differential pressures to each fluid channel and is only applicable in the low Reynolds number regime. The regulation of differential pressures makes the design inherently complex and, further, the requirement for pressure sources and regulators limits the feasibility of this method for portable instrumentation. The limitation with regard to the low Reynolds numbers regime makes the method impractical for the control of aqueous fluids in channels greater than approximately 100 microns. (Brody, J.P. et al., *Technical Digest, Solid-State Sensor and Actuator Workshop*, 1996, pp. 105-108; and Brody, J.P., *Biophysical Journal*, 1996, 71, pp. 3430-3441). Although valves may not be clogged with these approaches, the fluid channels themselves are likely to be clogged by suspended contaminants. Electrokinetic pumping and switching systems have also accomplished valveless fluid control in micron-scale devices. (Manz et al., *Advances in Chromatography*, 1993, 33, pp. 1-67.) Similarly, however, these designs are limited to the low Reynolds number regime, where micron-scale channels are prone to clogging. Further, these methods require large driving potentials, typically on the order of a kilovolt, and fluid flow that can be drastically affected by sample components adhering to the wall of the channel.